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Processes and benefits of the application of information technology in supply chain management: an analysis of the literature

Alexandre Pinheiro de Barros^{a*}, Celia Satiko Ishikiriya^b, Rafael Cordeiro Peres^c,
Carlos Francisco Simões Gomes^d

^{a, b, c, d}Production Engineering Department at Universidade Federal Fluminense, Niteroi 24210, Brazil

Abstract

The growth in the use and application of information technology (IT) in supply chain management (SCM) can be attributed to the performance improvements and value creation in organizations. In this sense, there has been a considerable evolution of scientific investigations into this integration over the past few years. This paper seeks to review, in a comprehensive and updated manner, the available scientific literature on business processes benefiting from the application of IT in SCM between the years of 2009 and 2014. The study identifies and analyzes the benefiting processes, and the benefits obtained in SCM. The paper concludes that there is a window of opportunity for advances in processes related to the production and development of products or services.

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Keywords: Supply Chain Management; Information Technology; Literature Review; Business Processes; Benefits.

1. Introduction

The growth in the use and application of information technology and systems (IT) in supply chain management (SCM) can be attributed to performance improvements and value creation in organizations.

Bandeira & Maçada (2008) emphasize that as a result of globalization, companies have started to concern themselves with information technology and the supply chain in order to obtain planned cost reductions. IT now supports the operations of companies, unites distant links of the supply chain and increasingly interconnects companies with its customers (CARR, 2003).

This study can be considered as comprehensive and up-to-date, since it takes into consideration and analyzes scientific articles published in the last five years to portray the most recent moment and the pursuit of

organizations to keep their technology parks constantly up to date within the framework of supply chain management.

This article identifies and analyzes the application of IT in SCM, gathering trends and gaps for future research. In this sense, the authors seek to answer the following questions: (i) which business processes benefit most from the adoption of IT?; and (ii) what are the main benefits obtained by these applications?

2. Theoretical Foundations

According to the Council of Supply Chain Management Professionals (CSCMP, 2013), SCM encompasses the planning and management of all activities involved in the supply, acquisition, conversion, management and logistics, within and between companies, with the function of integrating the main business functions and processes through a cohesive and high-performance business model.

For the Global Supply Chain Forum (GSCF), SCM means the integration of key business processes from the point of consumption until the point of origin, processes that are derived from products, services and information that add value for consumers and other stakeholders.

According to Ballou (2004), the target of SCM is to develop processes that will lead the organization to achieve its overall results through the development of activities that result in the maximum possible return in the shortest period.

In practice, the integration of multiple organizations can become a complex process that is difficult to manage. To support this process, IT can provide a number of tools to facilitate, streamline and increase the reliability of communications and the exchange of information between organizations.

This paper employs the main concepts and characteristics of two business models applied to SCM. One developed by the GSCF, and the other called Supply Chain Operations Reference-Model (SCOR). These models are used in this article to identify the processes that benefit most from the adoption of technologies in the SCM macro process.

The GSCF model was conceived by Douglas Lambert in 2001 and is based on the integration of key business processes through their supply chains. It includes 8 processes, namely: (i) customer relationship management, (ii) customer service management, (iii) demand management, (iv) order fulfillment, (v) production flow management (manufacturing or production), (vi) supplier relationship management, (vii) product development and marketing; and (viii) returns management (reverse logistics).

The Supply Chain Operations Reference-Model (SCOR) is a process model of reference developed by the Supply Chain Council (SCC) in 1996. SCOR is a tool that enables the focusing, improvement and communication of SCM practices. The SCOR model was developed to describe the business activities associated with all stages that influence consumer satisfaction and demand, and is based on five process management categories, with on the first level: Planning, Sourcing, Making, Delivering and Returning, which are described as follows:

- Planning: covers the entire planning and management process of the entire chain. In this step, resources and demand are defined, in addition to the planning of inventories, distribution, production and capacity.
- Sourcing, refers to the process of supplying the chain by acquiring and receiving raw material, maintaining relationships with suppliers and negotiating contracts with vendors.

- Making: involves all activities related to the manufacture of the final product, from production and testing, packaging and process adjustments, to the release and appropriation of products.
- Delivering: in addition to managing the storage, transport and shipment of orders and services, this process also involves credit management activities, in addition to creating the database of consumers, products and respective prices.
- Returning: processes that manage the returns of raw materials and final products, which also include maintenance, repair and inspection duties. This step also includes after-sales activities.

Table 1 describes the main differences between the GSCF and SCOR models, according to Donadel et al (2007).

Table 1. Summary of the comparison between the GSCF and SCOR models

Criteria	GSCF	SCOR
Focus	Relationship management	Transactional efficiency
Strategic Alignment	Corporate and functional area strategies	Operations strategy
Activities Scope	All activities related to the business processes implementation success	All transactional activities related to demand planning, supply, production, distribution and reverse logistics
Inter functional involvement	Integration and xxx of inter functional organization	Inter functional integration and information sharing
Process and benchmarking performance	Tools and techniques applied in business process activities	Data and information collection about benchmarking and best practices
Value creation	EVA (Economic Value Added)	Cost reduction and asset utilization

Source: Donadel et al (2007)

According to Scavarda et al (2010), "the process vision provides a systematic way for us to look at the organization, or more succinctly, the business, and once these processes are organized and integrated internally, the company can extend this integration to other members of the supply chain". The competitiveness of a company increases when its internal activities and business processes are integrated with the processes conducted by other organizations that belong to the same supply chain (LAMBERT & COOPER, 2000).

In this paper, the authors propose a new conceptual model for the evaluation of the benefits or impacts of the adoption of IT in SCM, which is comprised of the following dimensions represented by the diagram shown in Figure 1:

1. Cost reduction.
2. Operational efficiency and process improvement (i.e. increase in productivity; improvement in asset management and inventory control; increased agility and flexibility; reduction of delivery times; improved coordination and elimination of redundancies in processes or functions).
3. Quality, reliability, and accuracy of information (i.e. customer service and satisfaction; increased knowledge; and improved planning and management).
4. Integration and collaboration (i.e. improvement of coordination; management of partnerships; and communication between the supply chain agents).
5. Differentiation of products or services (i.e. increase of value-added; innovation and development of new products or services).

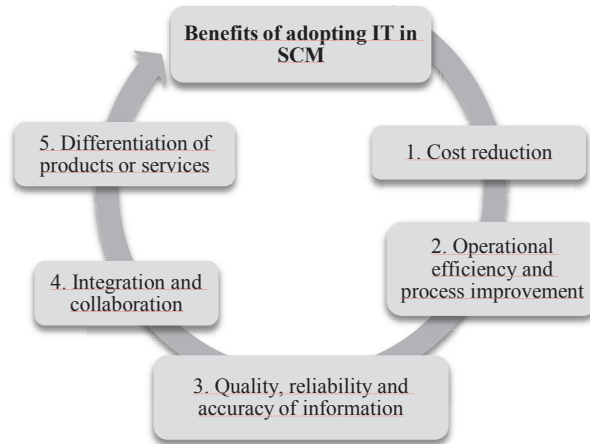


Fig. 1. Diagram for the evaluation of the impact/benefits of IT on SCM

3. Methodological Procedures

This study can be considered exploratory, given that the subject matter has been relatively little studied by academia. According to Gil (2010), studies of an exploratory nature aim to provide a greater familiarity with the problem, making it more explicit or constructing hypotheses for the improvement of ideas. The process of using multiple perceptions of multiple sources enables one to clarify ideas and make the study more robust, assisting researchers in a better understanding of the subject, the units of analysis and the practical validity of the constructs selected in the literature.

This study identifies and analyzes the application of IT in SCM, gathering trends and gaps for future research. A comparative study of scientific articles published since 2009 was chosen, which allowed the contrasting and comparison of phenomena that were recently observed and analyzed by academia, in different contexts and by different methods, journals and research institutions.

Figure 2 illustrates the methodology used by the authors in the development of this work.

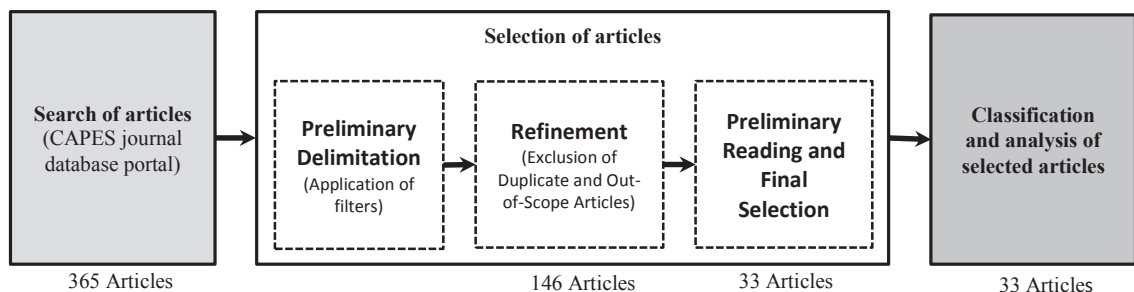


Fig. 2. Process of identifying, selecting and analyzing articles

The study was carried out in three stages, namely: (i) search for articles; (ii) selection of articles; and (iii) classification and analysis of selected articles.

The search or identification step was preceded by a review of the literature on the subject in order to obtain the search criteria and the units of analysis to be used in the subsequent steps of selection and analysis of articles. According to Easterby-Smith et al (2002), the literature review is an essential step in the structuring of studies in little explored fields of research. With respect to the definition of the unit of analysis, a study was chosen of the scientific articles in the most relevant journals and electronic journals for the IT and SCM fields, published over a horizon of five years since the year 2009, in order to get an analysis that could be considered recent. With respect to the choice of the research context, the databases made available by the CAPES Journal Portal were used, which include: Emerald, Springer, ScienceDirect (Elsevier), Directory of Open Access Journals (DOAJ), Wiley Online, World Scientific Journals, Scielo and Cengage Learning (Gale). The searches, carried out in October 2014, considered the exact keywords "supply chain management" and "technology information" in any part of the publications, for articles drafted in any language, and "supply chain management" or "management of the supply chain" and "information technology", which resulted in 365 articles.

For the selection step, the following sequence of activities was adopted: (i) delimitation; (ii) refinement; and, (iii) preliminary reading and final selection of articles. The following filters from search engines were used for the delimitation: inclusion of the topics "supply chain management" and "technology information"; exclusion of the set of journals from the biomedical field; and the option "peer reviewed journals". The 146 selected articles at this stage were then submitted to refinement, excluding repeated documents (duplication) and those considered out of scope. From there, a reading of the articles was initiated in order to select those that had a compatible approach with the subject of analysis, i.e. application or adoption of IT in SCM. According to Yin (2001), documentary research helps to highlight information that has been obtained through different sources. With the selection, the authors reached the number of thirty-three articles, as shown in Figure 3.

In the last step, the information of the 33 articles was consolidated and classified in a Microsoft Excel spreadsheet database, considering:

- Processes benefiting from the SCOR model, i.e. 1) Planning; 2) Sourcing or supply; 3) Production or manufacturing; 4) Delivery or distribution; and 5) Returns
- Processes benefiting from the GSCF model, i.e. 1) Customer relationship management; 2) Customer service management; 3) Demand management; 4) Order fulfillment; or 5) Production or manufacture flow management; 6) Supplier relationship management; 7) Product development and marketing; and 8) Returns management.
- Benefits or contributions obtained in supply chain management, i.e. 1) Cost reduction; 2) Operational efficiency and process improvement; 3) Quality, reliability and accuracy of information; 4) Integration and collaboration; or 5) Differentiation of products/services.

After the above classification, the information base obtained from the articles was analyzed quantitatively and qualitatively, observing the gaps and trends as laid out in the following section.

4. Analysis of Results

By cross-checking the research developed in the articles acquired with the SCOR model, the associated business activities were related and, therefore, the benefiting processes according to this methodology. As can be seen in Figure 3, the Planning process was mentioned in all the selected articles, and a greater emphasis on Sourcing or supply processes (88%), to the detriment of Delivery or distribution (79%) could also be observed. Production or manufacturing was the least cited (58%).



Fig. 3. Processes benefiting from the SCOR model

Similarly, another examination was carried out considering the GSCF model, as shown in Figure 4. Through this prism, one can also see that there is a higher concentration of analyses or citations of processes related to planning, i.e. to the quality of data and process improvement, namely: Demand management (91%) and Supplier relationship management (91%), Order fulfillment (88%) and Customer service management (85%). On the other hand, the Product development and marketing process is the least mentioned among the analyzed articles (22 articles).

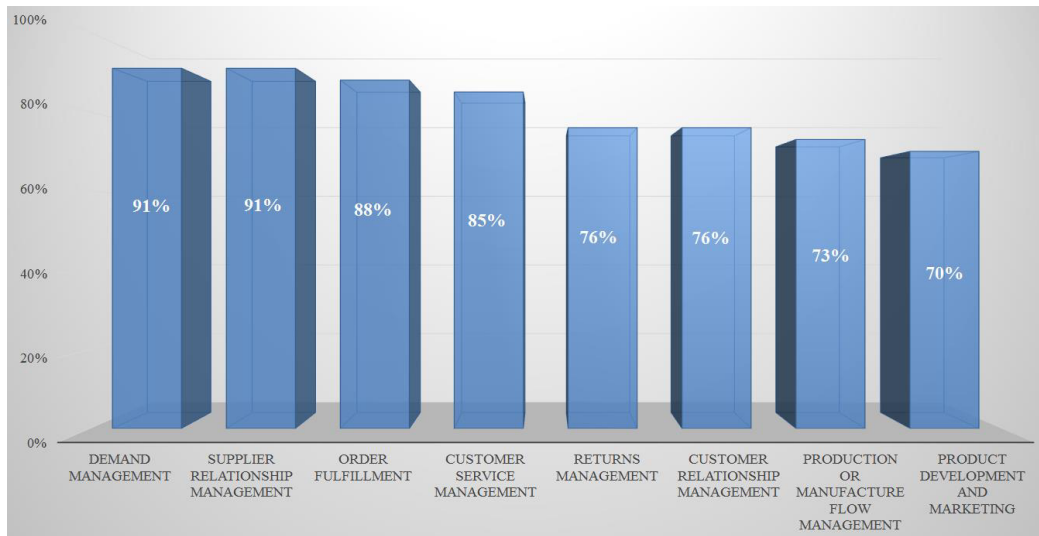


Fig. 4. Processes benefiting from the GSCF model

With respect to the conceptual model proposed in this article for the assessment of the benefits of adopting IT in SCM, the result of the analysis suggests that IT contributes to the management of the supply chain, especially in terms of Quality, reliability and accuracy of information (26 articles), Operational efficiency and process improvement (25 articles), and Integration and collaboration (23 articles), as can be seen in figure 5, demonstrating adherence to the process analyses presented earlier. In addition, an opportunity for IT advances can be observed in the context of the Differentiation of products or services, and Cost reduction, with respective references in 10 and 15 articles only.

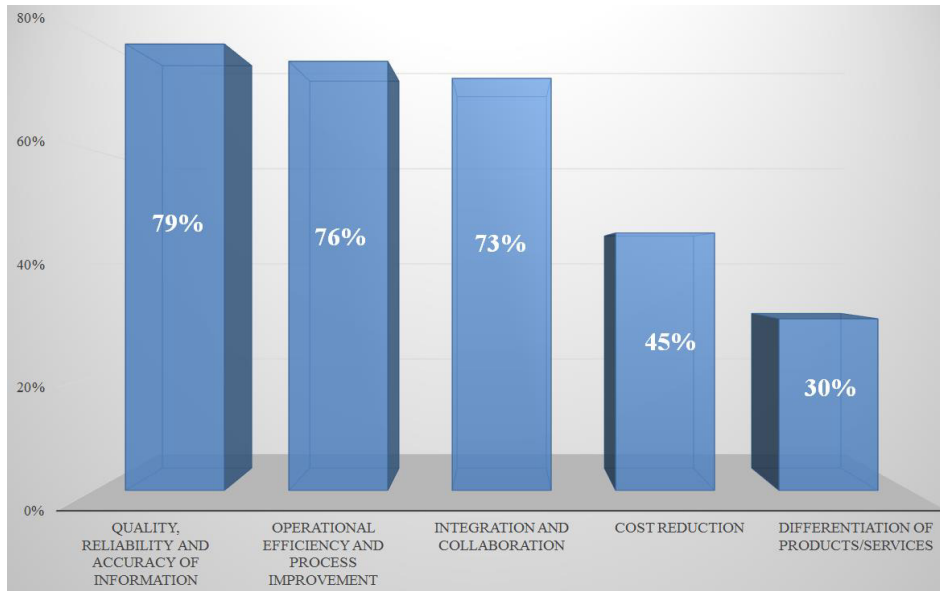


Fig. 5. Benefits generated by IT in SCM according to the model proposed by the authors

5. Conclusions

The objective of this paper was to use scientific articles published in a horizon of five years to identify and analyze the benefiting processes and the respective benefits obtained with the application of IT in the supply chain management of organizations.

The paper answered questions related to: (i) the business processes that benefited most by such adoptions; and (ii) the main benefits obtained by these applications in SCM.

Regarding the benefiting processes with the adoption, one can also see that there is a higher concentration of articles with analyses and citations of processes related to the planning macro-process, to the quality of information and the improvement of the management processes, and to the services rendered to all the actors in the supply chain. This analysis was confirmed with the presentation of the results on the main benefits obtained by organizations, according to the assessment model proposed by the authors, with an emphasis on the quality of information, process improvements and the collaboration between the actors.

This paper concludes that in terms of citations and analyses of recent scientific articles, there is a window of opportunity for IT advances in the context of SCM, especially regarding production processes (manufacturing) and the development of products or services.

The study was limited to the existing databases of the CAPES Journal Portal, and also to a specific horizon of analysis. For future studies on the subject of integration between IT and SCM, the authors suggest new research databases, a greater number of combinations of search terms, and an extension of the horizon of analysis.

References

- [1] Bandeira, R. A. D. M., & Maçada, A. C. G., 2008. Tecnologia da informação na gestão da cadeia de suprimentos: o caso da indústria gases. *Production Journal*, 18(2), 287-301.
- [2] Carr, N. G., 2003. TI já não importa. *Harvard Business Review*, 81(5), 30-37.
- [3] Council of Supply Chain Management Professionals. Available in <<http://cscmp.org/resources-research/glossary-terms>>. Accessed in 09/11/2014.
- [4] Ballou, R. H. (2004). Gerenciamento da cadeia de suprimentos: logística empresarial. Bookman.
- [5] Donadel, C. M., Kieckbusch R. E., Lorandi J. A. & Rodriguez C. M. T., 2006. O Modelo de referência das operações na cadeia de suprimentos (SCOR-Model). In: XXVI Enegep, Fortaleza.
- [6] Scavarda, L. F., De Carvalho, A. B., & Vieira, M. S., 2010. A reference matrix for information system in supply chain management. *Brazilian Journal of Operations & Production Management*, 3(1), 21-48.
- [7] Lambert, D. M., & Cooper, M. C., 2000. Issues in supply chain management. *Industrial marketing management*, 29(1), 65-83.
- [8] Gil, A. C., 2010. Métodos e Técnicas de Pesquisa Social. São Paulo: Atlas.
- [9] Easterby-Smith, M. P. V., Thorpe, R., & Lowe, A., 2002. *Management Research: An Introduction*.
- [10] Yin, R. K., 2001. Estudo de caso: planejamento e métodos (Vol. 2, No. 2, p. 1). Porto Alegre: Bookman.